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As Superintendent of the Forecast Division of the British Meteorological Office, Mr. Lempfert is well qualified to set forth the possibilities—and limitations—of the synoptic map, on which, as we all know, official forecasters rely.

The Weather Map is explained in detail, and the somewhat astonishing statement is made that "despite the fact that maps have now been drawn day by day for over half a century, we may safely say that no two maps have been identical." For that matter, no two snow crystals are identical; but they can be classified and grouped; and so can weather maps. This should have been added.

Mr. Lempfert writes in an easy and familiar way of the work of the forecasters during the Great War. The book begins with a study of a certain anticyclone which persisted from September 5 to 14, 1915. Probably because the author is a forecaster he realizes what most writers of meteorological books have failed to comprehend, namely, that the anticyclone is the dominating factor in determining weather sequences. Apparently it controls the path and speed of the "lows" following it.

There are different types of "highs," and, unfortunately, the Weather Map gives little indication of such difference. There are cloudless anticyclones and clouded anticyclones if the latter word may be allowed. In the cloudless type in summer, high temperatures prevail; and, as the condition is one of stagnation, there is an accumulation of heat in the lower levels and so a hot spell lasting several days—a period when the forecaster can promise no relief. In the same type during winter, because of free radiation, extremely low temperature may occur. In the other type of "high" the temperature amplitudes are limited, and conditions are more uniform. At such times surface readings of pressure and temperature may mislead the forecaster.

A good illustration of a "cyclone," "depression," or "low" is that of February 17, 1915; and the discussion loses nothing of interest when the author drives home the fact that two German airships were wrecked on the coast of Denmark through stress of weather. This happened, our author states plainly, because the German forecasters were unable to locate the center of the depression—which was over Ireland. With commendable frankness, however, he states that British forecasters, lacking definite information, would have been unable to do any better than their German colleagues. The reviewer, who happens to have had some experience in Europe during the war in connection with forecasting, ventures the opinion that if the matter could be investigated closely it would appear that delay in transmission of weather reports hampered the forecasters, for even in France it was no unusual thing to receive morning reports late in the afternoon.

The map for October 19, 1917, the date of the great Zeppelin raid, is given and is a good example of an anticyclonic wedge. An unexpected strong current from the north carried the air fleet (13 in number) out of course, on the return, and led ultimately to the loss of 8 airships—the flower of Germany's air fleet.

The chapters on Temperature and Clouds are brief but to the point. Only eight illustrations of cloud types are given. On page 47 the place of the highest sounding balloon record is given as Padua. We understand the record was made at Pavia.

In the chapter on the Stratosphere, on page 144, it is stated that the lowest recorded temperature "at ground level is 213a, observed on the great ice barrier of the Ross Sea on July 6th, 1911, by Captain Scott's expedition." We believe that there is an authentic reading of 205a (751 Kelvingrads, —68° C., —90° F.) at Verkhoyansk, February 5-7, 1891. This is erroneously given several degrees lower in Woeikof's "Meteorologie," 1910. In this chapter no mention is made of Professor Humphreys' explanation of the cause of the stratosphere: although proper mention is made of Gold's work on what may be called the radiation balance sheet for different levels of the atmosphere.

Other chapters deal with the thermal structure of the atmosphere, origin of changes of pressure, tropical storms, and the chemical composition of the atmosphere.

ALEXANDER MCADIE

#### CLIMATOLOGICAL ATLAS OF GERMANY

G. HELLMANN AND OTHERS. *Klima-Atlas von Deutschland*. 63 pp. of maps, 40 pp. of text. Dietrich Reimer (Ernst Vohsen), Berlin, 1921. \$7.00 bound. 12 x 14 inches.

The Prussian Meteorological Institute, with an enviable record of effective service to meteorology behind it, has added another important volume to its already long list of valuable publications. In the new "Klima-Atlas" of Germany, we have presented all the

essential facts concerning the climates of Germany (with the area it had before the war), both in cartographic and in tabular form. That the work was done under Hellmann is a sufficient guarantee of its accuracy. To him and to his co-workers, Professors G. von Elsner and H. Henze and Dr. K. Knoch, climatologists are under a real debt.

The Atlas includes 87 colored charts and 16 tables of climatic data. The scale of the maps is partly 1 : 4,250,000, partly 1 : 8,500,000, and, in the case of the monthly rainfall maps, 1 : 1,250,000, in order that the local peculiarities of the distribution of precipitation may be clearly brought out. The basic period is in general 30 years, 1881-1910, except in the case of rainfall, where it is 20 years (1893-1912). These periods were selected because they include the largest series of reliable homogeneous observations. All records covering shorter periods than these were reduced to the basic periods.

The charts show the annual and monthly isotherms, isobars and average wind directions, and vapor pressures, all at sea level; also the relative humidity, cloudiness, and precipitation at the earth's surface. There are, in addition, single charts of the annual range of the monthly mean temperatures, the mean annual number of days with rainfall of at least 0.1 millimeter; of days with snowfall (melted) of at least 0.1 millimeter; and of the month of greatest rainfall; least rainfall; greatest and smallest number of rainy days (0.1 millimeter and over); average annual number of clear days and average annual number of cloudy days. The rainfall maps are especially instructive because of the light they throw on the local topographic effects, which are well marked in the south and west, while the distribution of rainfall over the great lowlands of the north and east is fairly uniform. Further, the general warm-season, "continental" rainfall maximum is clearly seen on comparing the winter with the summer maps.

Many comments suggest themselves to the reviewer, but to begin with details would inevitably lead to a lengthy discussion. Three points only will be noted. The first is the interesting fact that the northern base of the Harz Mountains as well as of the Alps shows, in several months and for the year, local favorable temperature conditions which are doubtless due to the *föhn* wind. The second comment concerns the absence of any charts of actual (surface) temperatures. While sea-level isotherms are indispensable in any broad studies of the controls of climate by land and water, it is the actual temperatures, not reduced, that are dominating factors in plant and animal life. As time goes on and as more complete temperature observations become available, isothermal charts showing actual temperatures will inevitably be more and more often used. It would seem that in the case of Germany, with a fairly fine-meshed net of meteorological stations, charts showing the actual temperatures might even now be drawn with a very reasonable degree of accuracy and without the necessity of too much interpolation. The third comment concerns a rather conspicuous absence of sunshine maps in the Atlas. The explanation, as is to be expected, is the lack of sufficient data for constructing good maps of this sort.

Those who have kept in touch with recent publications on the climatology of Germany will see in the new Atlas the completion, in final form, of numerous studies by Hellmann which have appeared during the past two decades. Mention may here be made of a considerable series of small rainfall maps of separate parts of Germany, with brief discussion, and a general rainfall map of the country as a whole, the first edition of which bears the date 1906 and the second 1919 (Dietrich Reimer, Berlin). There are two other recent papers on rainfall ("Neue Untersuchungen über die Regenverhältnisse von Deutschland," Erste Mitteilung, *Sitzungsber. Königl. Preuss. Akad. der Wiss.*, Berlin, 1919, Part I, pp. 417-432; Zweite Mitteilung, *ibid.*, 1921, pp. 246-257). The second of these papers shows lines of equal annual numbers of days with snowfall. Hellmann has also recently published a paper on the isotherms of Germany ("Die Isothermen von Deutschland," *ibid.*, 1920, pp. 369-376; Pls. 2) and on cloudiness in Germany ("Die Nebel in Deutschland," *ibid.*, 1921, pp. 900-919).

R. DEC. WARD

#### IRRIGATION AS AN INSTITUTION IN THE WEST

GEORGE THOMAS. *The Development of Institutions under Irrigation, with Special Reference to Early Utah Conditions.* vii and 293 pp.; map, ill., index. (The Rural Science Ser., L. H. Bailey, edit.) The Macmillan Co., New York, 1920. \$2.75. 7½ x 5 inches.

Dr. Thomas has made a valuable contribution to the literature of irrigation in the United States. The first attempts in this country to develop irrigation co-operatively